

REMARKS

Reconsideration and allowance of the above-identified Application in view of the above amendments and the following remarks are respectfully requested.

Claims 1, 3-8, and 10-16 are pending, claims 2 and 9 being cancelled herein.

Claims 1-4, 7 and 9 stand rejected under 35 U.S.C. §102 as being anticipated by U.S. Pat. No. 6,391,785 to Satta et al. ("Satta"). Applicant respectfully traverses the rejection.

Claim 1 has been amended to incorporate the subject matter of original claims 2 and 9, while claims 2 and 9 have been cancelled. Claim 1 as amended recites that a tungsten nitride layer is deposited as a barrier metal layer in a contact hole and on an insulating layer. It further recites that the depositing comprises depositing a silicon single atomic layer in the contact hole, forming a tungsten single atomic layer and forming the tungsten nitride layer by plasma-processing the tungsten single atomic layer. Finally, claim 1 has been amended to clarify that the silicon monolayer is deposited prior to the deposition of the tungsten monolayer. Satta fails to teach or suggest such a method.

In particular, Satta does not teach or suggest depositing a silicon single atomic layer in a contact hole in conjunction with depositing a tungsten single atomic layer, then plasma-processing the tungsten single atomic layer to form the tungsten nitride layer. The office action points to col. 5, ll. 10-30 and col. 7 ll. 40-46 and Figs. 1 and 2 in support of its assertion that Satta teaches a single atomic layer of silicon, forming a single atomic layer of tungsten and plasma-processing the tungsten layer to form a tungsten nitride layer. Applicant respectfully disagrees with this characterization of the reference. Nothing in Satta teaches or suggests that a single atomic layer of a two different materials may be desirable. In contrast, Satta simply teaches that in an atomic layer deposition process, multiple layers of a single material are deposited. For example, Satta teaches that "The barrier layer 26 can be, but is not limited to, *a material* selected from...." (emphasis added). Nothing in Satta contemplates the use of more than a single material. Cycles of a particular gas for ALD are alternated, but no example describes or suggests alternating source gases between cycles. Table I, for example, includes parameters for depositing a number of atomic monolayers of Ti, but does not teach anything about a layer of Si in conjunction with a layer of Ti. More particularly, it does not teach that a silicon monolayer should be deposited prior to deposition of a tungsten monolayer.

As described in the specification of the present application, the silicon layer provides a protective layer for the contact hole, preventing damage from the introduction of, e.g., WF₆

gas into the reaction chamber. Satta does not teach or suggest a method having this feature. In contrast, Satta specifically teaches the desirability of a direct metal-to-metal contact and that it is undesirable to have any material in the contact hole deposited on the conductive bottom wall 10, let alone a layer of a material different from the bulk barrier layer. See, for example, col. 2, ll. 7-17, describing various disadvantages when the barrier layer overlies the bottom wall 10. In short, Satta is directed to an entirely different problem and does not in any way point to the solution provided by the present invention.

Because Satta fails to teach or suggest all of the elements of claim 1, it cannot anticipate claim 1 and Applicant respectfully requests that the rejection of claim 1 be withdrawn.

Claims 3-8, and 10-16 each depend, directly or indirectly from claim 1 and are patentable for at least the same reasons as claim 1, as well as for the additional recitations therein. With respect to the rejection under 35 U.S.C. §103, Applicant respectfully submits that Kang does not overcome the deficiencies of Satta with respect to the recitation in claim 1 of depositing a silicon monolayer prior to depositing a tungsten monolayer in conjunction with the remaining elements of claim 1. Applicant respectfully requests that the rejection based on Kang under 35 U.S.C. §103 be withdrawn.

Applicant has addressed all the Examiner's rejections and objections and respectfully submits that the application is in condition for allowance. A notice to that effect is earnestly solicited.


If any point remains in issue which the Examiner feels may be best resolved through a personal or telephone interview, please contact the undersigned at the telephone number listed below.

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Please charge any fees associated with the submission of this paper to Deposit Account Number 033975. The Commissioner for Patents is also authorized to credit any over payments to the above-referenced Deposit Account.

Respectfully submitted,

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